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SURFICIAL GEOLOGY AND TILL GEOCHEMISTRY (Au, Ag, As, Hg, Sb, Cu, Pb, Zn, Co, Ni, Mo, Mn, Fe and W) OF RILEY BROOK (21 O/3) MAP AREA, NEW BRUNSWICK

by

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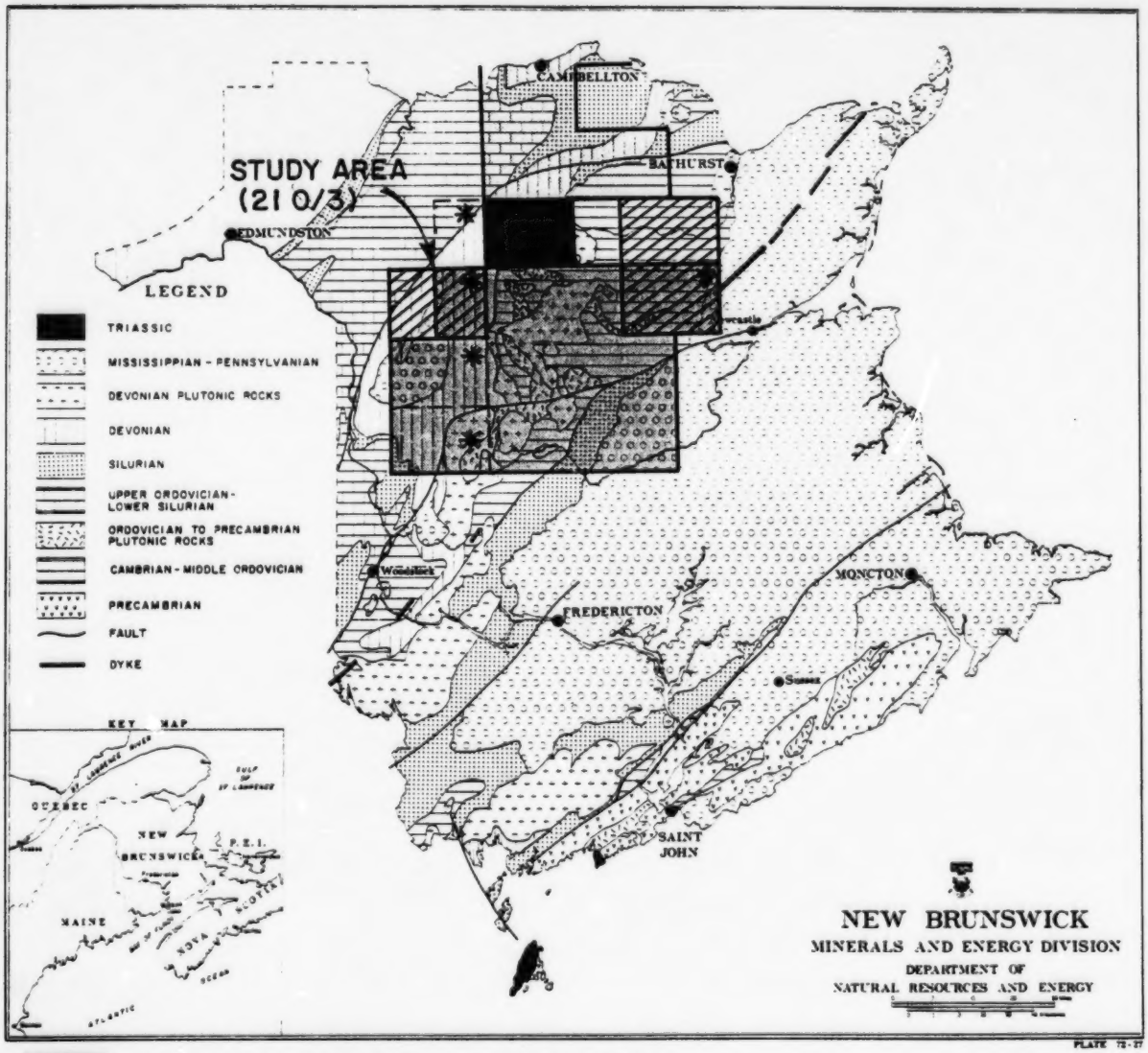
SURFICIAL GEOLOGY AND TILL GEOCHEMISTRY (Au, Ag, As, Hg, Sb, Cu, Pb, Zn, Co, Ni, Mo, Mn, Fe and W) OF RILEY BROOK (21 O/3) MAP AREA, NEW BRUNSWICK

INTRODUCTION

The Riley Brook (21 O/3) map area (Figure 1) was chosen as part of the till geochemistry/surficial mapping project because the area lies within the Tobique-Chaleur volcanic belt, an area of recent exploration activity (Wilson 1988). It was funded by the Canada-New Brunswick Mineral Development Agreement. In 1988, NovaGold Resources Inc., Corona Corporation, Rio Algom Exploration Inc. and Northeast Exploration Services Limited were actively prospecting for gold in the area, while Inco Gold Company and Noranda Exploration Company, Limited were carrying out regional surveys to the north.

Government surveys in the area include bedrock mapping by the Geological Surveys Branch of the Department of Natural Resources and Energy (Wilson 1988) and stream-sediment and water geochemistry by the Geological Survey of Canada (P.W.B. Friske, pers. comm., 1988). The southeastern half of the area was also part of the Miramichi regional till mapping and sampling project carried out by the Geological Survey of Canada (Lamothe 1988). Gold values of up to 6 ppb were reported from the 40 sample sites in the eastern half of the Riley Brook map area.



1989 study area of Pronk and Parkhill

Friske (1988) study areas

Lamothe (1988) study area
(* partial sheet included in study)

Previous study areas

Figure 1. Riley Brook study area (21 O/3) in relation to other recently published geochemistry surveys. Wilson (1988) and Friske (1989) also carried out projects in the study area.

GLACIAL HISTORY AND DEPOSITS

The Riley Brook map area can be divided into three broad zones based on its surficial geology (Plate 89-71A). The northwest half of the area is underlain by Ordovician/Silurian sedimentary rocks with minor Devonian intrusive rocks. Topography is flat to undulating and tills are generally thin, monolithologic, and locally derived. This area is part of the Chaleur Uplands (Rampton et al. 1984). Canadian Shield erratics (Precambrian granites and anorthosites) are present on top of and/or in the upper part of the till (Plate 89-71A). None of these have been found east of the Tobique River (Miramichi Highlands) or in the Tobique Basin (Rampton et al. 1984; Pronk et al., in press). The Tobique Basin is underlain by Carboniferous sedimentary rocks, which have resulted in predominantly red tills in the south-central part of the map area.

The eastern half of the map area, part of the Miramichi Highlands, is underlain by Devonian volcanic, sedimentary, and minor intrusive rocks (Wilson 1988). The basal till lithologies reflect the more diverse bedrock geology. There are several valleys that have an ablation cover over basal till and/or bedrock, e.g., Osser Brook (north of Bald Peak), South Dead Brook and the upper reaches of Blue Mountain Brook and Stewart Brook at the southwestern end of the Black Mountains, and the area around the headwaters of the River Dee and North Branch Gulquac River.

Striae indicate early movement off the Miramichi Highlands to the south-southwest followed by an eastward flow (090°-120°; Rappol 1988). A later southeastward flow

120°-170°) was probably influenced by pressure from Laurentide ice to the northwest and finally by local ice flow off the Miramichi Highlands to the south-southwest and north-northeast (Pronk et al., in press).

A thorough description of ice movement indicators and their application to mineral exploration has been written by A.A. Seaman (in preparation).

SAMPLING AND ANALYTICAL PROCEDURES

Samples were taken from C-horizon basal till on a 2 km grid spacing. The dry-sieved minus 0.063 mm (silt-plus-clay) fraction was used for geochemical analyses. Chemex Labs of Vancouver, B.C. analysed sample splits for Au, Ag, As, Hg and Sb (analytical methods are indicated on Plate 89-71B) and the Geological Surveys Branch geochemistry laboratory in Fredericton analysed splits for Cu, Pb, Zn, Co, Ni, Mo, Mn, Fe and W (methods indicated on Plates 89-71C and 89-71D). Standard reference and duplicate samples were submitted in order to control sample reproducability and analytical accuracy. All samples that returned significant gold values were resubmitted for analysis. Analytical results were grouped as follows; Au, Ag, As, Hg, Sb (Plate 89-71B); Cu, Pb, Zn, Co, Ni (Plate 89-71C); and Mo, Mn, Fe, W (Plate 89-71D).

Where a discontinuous cover of ablation till was present, underlying basal till was sampled to assure a single medium for the sample population. This was done by either moving the sample site or penetrating the ablation cover.

Summary statistics, generated using a Statgraphics (version 3.0) software package, are presented in Table 1.

Table 1. Summary Statistics

Variable	Au	Ag	As
Sample size	291	291	291
Average	1.62405	0.103093	8.00344
Median	0.5	0.1	7
Mode	0.5	0.1	6
Geometric mean	0.933934	0.101965	7.26
Variance	8.26321	4.38678E-4	25.9552
Standard deviation	2.87458	0.0209446	5.09462
Standard error	0.168511	1.2278E-3	0.298652
Minimum	0.5	0.1	3
Maximum	27	0.3	59
Range	26.5	0.2	56
Lower quartile	0.5	0.1	6
Upper quartile	2	0.1	9
Interquartile range	1.5	0	3
Skewness	5.37364	7.48663	5.78173
Standardized skewness	37.4231	52.1383	40.2651
Kurtosis	35.8873	60.0371	46.6694
Standardized kurtosis	124.963	209.055	162.507

Table 1 (continued)

Variable	Hg	Sb	Cu
Sample size	291	291	291
Average	77.7663	0.293471	19.9485
Median	65	0.1	20
Mode	60	0.1	20
Geometric mean	67.5621	0.135406	18.5146
Variance	5032.64	2.43413	75.6766
Standard deviation	70.9411	1.56017	8.69923
Standard error	4.15864	0.0914588	0.509958
Minimum	20	0.1	4
Maximum	1100	22	110
Range	1080	21.9	106
Lower quartile	50	0.1	15
Upper quartile	90	0.2	23
Interquartile range	40	0.1	8
Skewness	10.6625	12.2716	4.36759
Standardized skewness	74.2556	85.4617	30.4167
Kurtosis	149.438	156.684	40.8507
Standardized kurtosis	520.359	545.587	142.246

Table 1 (continued)

Variable	Pb	Zn	Co
Sample size	291	291	291
Average	23.5636	55.6289	16.8797
Median	22	55	17
Mode	19	60	16
Geometric mean	22.2013	52.7291	16.3489
Variance	112.543	324.751	17.3062
Standard deviation	10.6086	18.0209	4.16007
Standard error	0.62189	1.0564	0.243868
Minimum	7	5	7
Maximum	137	150	27
Range	130	145	20
Lower quartile	19	45	14
Upper quartile	26	62	20
Interquartile range	7	17	6
Skewness	5.48875	1.29164	0.226593
Standardized skewness	38.2247	8.99523	1.57804
Kurtosis	49.1552	4.75903	-0.141547
Standardized kurtosis	171.163	16.5714	-0.49288

Table 1 (continued)

Variable	Ni	Mo	Mn
Sample size	291	291	291
Average	48.6598	1.45704	319.976
Median	47	1	271
Mode	49	1	156
Geometric mean	45.8416	1.36161	279.896
Variance	274.901	0.338666	54754.7
Standard deviation	16.5801	0.58195	233.997
Standard error	0.971945	0.0341145	13.7172
Minimum	8	1	73
Maximum	123	6	2915
Range	115	5	2842
Lower quartile	39	1	210
Upper quartile	56	2	369
Interquartile range	17	1	159
Skewness	0.876938	2.01814	6.32127
Standardized skewness	6.10716	14.0547	44.0226
Kurtosis	1.72146	11.879	60.1669
Standardized kurtosis	5.99429	41.3639	209.507

Table 1 (concluded)

Variable	Fe	W
Sample size	291	291
Average	2.7189	2.21993
Median	2.6	2
Mode	2.5	2
Geometric mean	2.60472	2.14304
Variance	0.609952	0.641119
Standard deviation	0.780994	0.800699
Standard error	0.0457827	0.0469378
Minimum	0.8	2
Maximum	6.4	8
Range	5.6	6
Lower quartile	2.3	2
Upper quartile	3.1	2
Interquartile range	0.8	0
Skewness	0.88144	4.7768
Standardized skewness	6.13852	33.2666
Kurtosis	3.45523	27.6308
Standardized kurtosis	12.0314	96.2133

GEOCHEMISTRY AND EXPLORATION IMPLICATIONS

Glacial transport seems to have been mostly local, although some mixing has taken place on the Highlands, partly as a result of relief. Transport distance of fines seems to be best indicated by reddish tills to the east of the Carboniferous outlier in the Tobique Basin. Tills are red at about 10 km east from their source rock outcrop. A project has been initiated by the authors to compare till lithology and till geochemistry by examining the geochemical composition of the pebble-size material.

Seaman (in press) shows that there are a number of problems related to drift prospecting in New Brunswick, where glaciation is mostly regional rather than continental. One of the major problems is the fact that glacial transport and deposition did not necessarily take place in the direction of the most abundant striae orientations. Another is that tills with different transport-deposition histories can be present on opposite sides of a topographic feature. Detailed till fabric and pebble lithology analyses are necessary to determine this history at each locality. These problems need to be understood before drift prospecting can be utilized effectively in the Province.

Till lithology seems to be one of the most reliable methods of tracing the source of anomalies, followed by fabric analysis and striae orientations. Little data is available for relating till geochemistry to till lithology.

In the past, published gold values have been questioned because of unsuccessful attempts to duplicate the results. It was suggested that contamination may have originated in the sample processing step. A thorough discussion of sample representativity is presented by Nichol et al. (1989). The Geological Surveys Branch has researched several aspects of gold geochemistry and will continue to publish gold analyses. To verify the results, all samples with significant gold values were resubmitted for analyses and the sample split results are also indicated. Sites where values could not be reproduced and pathfinder elements showed no elevated concentrations (e.g., sample sites L-12 and M-12) should be looked upon with care. Most significant gold values (more than 10 ppb) are associated with known mineral occurrences (Rose and Johnson, in preparation), known bedrock mineralization (Wilson 1988), and/or elevated pathfinder elements (As, Ag, Sb and Hb).

Site A-7, west of Salmon River, has anomalous gold, arsenic, and antimony that might be related to gabbroic intrusions in the area. Other slightly elevated values for gold, silver, arsenic and mercury are present along the Rocky Brook-Millstream break to the northeast (sites C-4, D-5, E-3, E-4, and F-3) and possibly related to similar gabbroic intrusions (R. Wilson, pers. comm., 1988) although no mineralization has been encountered in bedrock outcrops.

A large area of elevated antimony values, parallelling the Tobique River, stretches from Lower Blue Mountain in the south to Bear Brook in the north. Highly anomalous antimony values are present at sites M-9, N-4, and N-6. This "anomaly" partly overlaps an area of elevated arsenic values that stretches from Upper Blue Mountain to Nictau. Sites N-6 and M-9 again are highly anomalous. High mercury (N-4 and N-11) and locally low gold values fall within the zone of higher arsenic and antimony values.

Anomalous mercury and arsenic, and minor antimony values are present in the area of the Black Mountains. A few low gold and silver values are associated with them. Farther to the northeast in the same belt of volcanic rocks between Neary Pond and Baldwin Lake, a similar anomaly is present. High arsenic and mercury values are accompanied by elevated silver and antimony values and anomalous gold values (sites V-3, V-4, W-3, W-4, and W-5). Wilson (1988) reported several mineralized outcrops in the same general area.

In the southeast corner of the map area (Gulquac Mountains) where several mineral occurrences are present, a number of arsenic, antimony, and mercury highs are accompanied by scattered elevated gold and silver values.

In 1989 the northeastern extension of the Tobique-Chaleur volcanic belt will be the focus of bedrock (21 O/2,6,7) and surficial mapping and sampling (21 O/7) by Geological Surveys Branch staff.

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MAPS NOT FILMED

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